

Caridina zhaoi sp. nov., a new stygobiont atyid shrimp (Decapoda, Caridea, Atyidae) from a limestone cave in Guizhou Province, China

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Abstract

A new stygobiont species of freshwater shrimp, *Caridina zhaoi* sp. nov., from a karst cave in Guiyang, Guizhou Province, southwestern China, is described and illustrated. The new species is morphologically distinct from its epigean congeners by a suite of stygobiotic characters, including the degeneration of eyes and absence of body pigmentation. It can be further distinguished from other known Chinese cavernicolous *Caridina* species by the combination of a relatively long rostrum with a specific rostral formula, the length of the stylocerite, the proportions of various joints of the first and second pereopods, and the armature of the dactylus of the third and fifth pereopods. Molecular analysis based on the mitochondrial COI gene reveals a high genetic divergence (14.70%–23.47%) between the new species and other atyids, supporting its validity as a distinct species. This discovery brings the total number of stygobiont *Caridina* species in China to 10, highlighting the rich but underestimated subterranean biodiversity of the Guizhou karst region.

Key Words

COI, Crustacea, morphology, stygofauna, subterranean biodiversity, taxonomy

Introduction

The freshwater shrimp family Atyidae constitutes a vital component of aquatic ecosystems globally, playing critical roles in nutrient cycling and food webs. This diverse family exhibits a wide geographic distribution, with particularly high species richness in tropical and subtropical regions (De Grave et al. 2008, 2015). Many atyid species have evolved specialized adaptations to inhabit unique environments, ranging from swift-flowing mountain streams to isolated subterranean water systems (De Grave et al. 2008).

Subterranean ecosystems, characterized by perpetual darkness, limited food resources, and stable environmental conditions, harbor a highly specialized group of organisms known as stygofauna/troglofauna. These animals often exhibit striking morphological adaptations,

such as the complete loss of pigmentation (albinism), reduction or loss of eyes, and elongated appendages, collectively termed stygomorphy/troglomorphy (Culver and Pipan 2019). Such convergent evolution makes stygofauna an invaluable model for studying adaptive evolution, speciation mechanisms, and phylogeography (Sket 2008; Juan et al. 2010).

China possesses one of the most extensive and complex karst landforms. The southwestern region, particularly Guizhou Province, is a major area for subterranean biodiversity (Deharveng and Bedos 2018). The dense network of interconnected caves and underground rivers in this area creates ideal conditions for the diversification and endemism of stygofauna. However, the cryptic subterranean invertebrates, such as stygobiont atyid shrimp, remain significantly underexplored.

Currently, eight species of cave-dwelling atyids are recorded from Guizhou. The distribution of these known species is highly uneven, clustered primarily in two regions, Libo County and Tongren City, with no records in other areas due to insufficient surveys. Among them, five are considered stygobionts, i.e. *Caridina demenica* Cai & Li, 1997, *C. caverna* Liang et al., 2005, *C. acuta* Liang et al., 2005, *C. incolor* Feng et al., 2021, and *C. sinanensis* Xu et al., 2020 (Cai and Li 1997; Liang et al. 2005; Cai and Ng 2018; Xu et al. 2020; Feng et al. 2021). During a recent biospeleological survey in Guiyang, central Guizhou, a population of depigmented, anophthalmic shrimp was discovered. Based on morphological characters and DNA data, this population represents a lineage distinct from all currently known Chinese atyids. Herein, we formally describe this new species as *Caridina zhaoi* sp. nov.

Materials and methods

Specimen collecting and preservation

Specimens were collected using cage nets and dip nets from a limestone cave in Guiyang, Guizhou, southern China. Live specimens were observed and photographed with a Sony A7R4A camera fitted with a Sony FE 90 mm macro lens. The specimens were preserved in 75% ethanol and deposited at the Guizhou Institute of Biology, Guizhou Academy of Sciences, Guiyang, China (IBGAS).

Morphological study

Specimens were examined, photographed, and measured using a Leica M205A stereomicroscope equipped with a Leica DFC450 camera and LAS X software (v. 5.1, Leica, Germany). Hand-drawn illustrations were based on these photographs and edited with Adobe Photoshop CC 2019 software (v. 20.0.0, Adobe, USA).

The following abbreviations are used in the text: **alt** (altitude), **cl** (carapace length, measured from the postorbital margin to the posterior margin of the carapace), **rl** (rostral length, measured from the rostral tip to the postorbital margin) and **tl** (total length, measured from the rostral tip to the posterior margin of the telson). All measurements are in millimeters.

Molecular analyses

Genomic DNA was extracted from two specimens of *Caridina zhaoi* sp. nov. (sample numbers 729 and 730 for Dec-aty-00538-9 and 10). The mitochondrial COI gene was amplified using the primer pair HCO2198 / LCO1490 (Folmer et al. 1994). Sequences of twelve *Caridina* species from China were retrieved from GenBank for comparison, including the cavernicolous species *C. cavernicola* Liang & Zhou, 1993, *C. sinanensis*, *C. incolor*, and *C. longshan* Cai & Ng, 2018. Two species

of *Neocaridina*, *Sinodina ashima* Jiang et al., 2023 and *Paracaridina guizhouensis* (Liang & Yan, 1986) were also included in the matrix. *Macrobrachium nipponense* (De Haan, 1849) from Palaemonidae was selected as the outgroup. Detailed information is listed in Table 1.

The COI sequences were aligned and trimmed in MEGA 12.0 (Stecher et al. 2025). The pairwise p-distances between COI genes of all specimens of *Caridina* spp. were calculated with MEGA 12.0.

Maximum likelihood (ML) and Bayesian inference (BI) analyses were conducted to infer the phylogeny. PARTITIONFINDER 2 (Lanfear et al. 2016) was used to determine the optimum partitioning scheme and the best-fitting model for each codon positions, using the corrected Akaike Information Criterion (AICc). ML was performed in IQ-TREE v. 3.0.1 (Wong et al. 2025), using 1000 rapid bootstrap replicates. BI was implemented in MRBAYES v. 3.2.5 (Ronquist et al. 2012) with two simultaneous Monte Carlo Markov (MCMC) runs for 1.5 million generations, and tree samples were output every 1000 generations with a burn-in of 25%. Analyses terminated with the standard deviation of split frequencies below 0.01. Trees were visualized and edited with FIGTREE v. 1.4.4 (Rambaut 2016).

Results

Molecular analyses results

The final aligned COI dataset comprised 622 base pairs. The intraspecific genetic distance for the new species was 1.13%. Interspecific genetic divergence was high, ranging from 14.70% (with *C. sinanensis*) to 23.47% (with *C. serratirostris* De Man, 1892) (Table 2), which was significantly larger than the intraspecific distance.

The best-fitting evolutionary model for each codon positions were SYM+I+G, HKY+I and TVM+G respectively. Both the ML tree and BI tree showed low resolution for the phylogenetic relationships among these species. Only a few sister groups received support in both trees, including (*C. lanceifrons* Yu, 1936 + *C. zhujiangensis* Chen et al., 2018), (*C. longshan* + *C. incolor*), (*N. hofendopoda* (Shen, 1948) + *N. palmata* (Shen, 1948)), and (*C. mariae* Klotz & Rintelen, 2014 + (*C. cantonensis* Yu, 1938 + *C. zhongshanica* Liang, 2004)). Although the phylogenetic placement of this new species remained unresolved in the present analysis, it clearly formed an independent lineage (Fig. 1).

Taxonomy

Caridina zhaoi sp. nov.

<https://zoobank.org/97967096-ED9D-41D7-ABA9-0C0AB8235050>

Figs 2B, 3–4

Type material. *Holotype* • male (rl 2.1 mm, cl 4.9 mm, tl 19.3 mm), Dec-aty-00538-1, China, Guizhou Province, Guiyang City, Wudang District, Anduo Village, Xiangshui

Table 1. Details of the species used for the molecular analyses.

Species	Sampling locality	Habitat	GenBank number	Reference
<i>Caridina zhaoi</i> sp. nov.	Wudang, Guizhou	subterranean	PX972271, PX972272	This study
<i>Caridina cantonensis</i>	Qingyuan, Guangdong	epigean	AB300190	Shih and Cai 2007
<i>Caridina cavernicola</i>	Mashan, Guangxi	subterranean	MZ753498	Guo et al. 2022
<i>Caridina huananensis</i>	Yingde, Guangdong	epigean	MN701608	Chen et al. 2020
<i>Caridina incolor</i>	Libo, Guizhou	subterranean	MW237744	Feng et al. 2021
<i>Caridina lanceifrons</i>	Dongfang, Hainan	epigean	MN701606	Chen et al. 2020
<i>Caridina longshan</i>	Longshan, Hunan	subterranean	OP177695	Zhao, unpublished
<i>Caridina mariae</i>	Huizhou, Guangdong	epigean	MN701601	Chen et al. 2020
<i>Caridina serratirostris</i>	Indonesia	epigean	MN526148	Hernawati et al. 2020
<i>Caridina sinanensis</i>	Sinan, Guizhou	subterranean	MT433963	Xu et al. 2020
<i>Caridina tetrazona</i>	Zhuhai, Guangdong	epigean	MN701593	Chen et al. 2020
<i>Caridina zhongshanica</i>	Zhongshan, Guangdong	epigean	MN701597	Chen et al. 2020
<i>Caridina zhujiangensis</i>	Zhuhai, Guangdong	epigean	MN701603	Chen et al. 2020
<i>Sinodina ashima</i>	Shilin, Yunnan	subterranean	OR536642	Jiang et al. 2023
<i>Neocaridina palmata</i>	Hezhou, Guangxi	epigean	OR536639	Jiang et al. 2023
<i>Neocaridina hofendopoda</i>	Sanjiang, Guangxi	epigean	OR536640	Jiang et al. 2023
<i>Paracaridina guizhouensis</i>	Yuping, Guizhou	epigean	OR536641	Jiang et al. 2023
<i>Macrobrachium nipponense</i>	Qinglong, Guizhou	epigean	OR536638	Jiang et al. 2023

Table 2. Pairwise p-distance (%) for *COI* sequences.

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. <i>C. zhaoi</i> sp. nov. (729)													
2. <i>C. zhaoi</i> sp. nov. (730)	1.13												
3. <i>C. cantonensis</i>	18.01	17.68											
4. <i>C. cavernicola</i>	15.94	15.46	15.46										
5. <i>C. huananensis</i>	17.52	17.52	16.72	14.17									
6. <i>C. incolor</i>	17.34	17.50	18.48	17.53	17.67								
7. <i>C. lanceifrons</i>	21.70	22.35	19.29	20.77	19.77	20.42							
8. <i>C. longshan</i>	15.43	15.59	15.92	14.81	18.01	15.88	18.65						
9. <i>C. mariae</i>	18.65	18.49	9.65	15.46	16.08	18.96	20.10	17.04					
10. <i>C. serratirostris</i>	23.47	23.31	21.70	20.93	21.22	21.88	21.06	22.35	21.22				
11. <i>C. sinanensis</i>	14.70	14.86	15.19	12.92	13.73	15.31	19.06	13.57	16.16	21.16			
12. <i>C. tetrazona</i>	18.49	18.49	13.67	14.65	15.43	18.31	19.61	16.72	14.79	20.58	15.67		
13. <i>C. zhongshanica</i>	17.52	17.20	2.57	15.30	15.59	18.64	19.13	16.24	8.84	21.54	15.51	13.67	
14. <i>C. zhujiangensis</i>	19.61	19.29	17.68	16.59	18.97	19.29	17.68	18.01	20.10	21.70	17.61	19.61	18.01

Cave, 26°44'18.91"N, 106°46'23.08"E, alt. 1390 m, 15. III. 2024, Zhao Fei & Zhou Jiajun leg. **Paratypes** • 2 males (rl 2.6–2.9 mm, cl 5.1–5.4 mm, tl 21.2–21.4 mm) and 7 females (rl 1.3–3.3 mm, cl 4.2–7.9 mm, tl 15.1–30.4 mm), Dec-aty-00538-2–10, same data as holotype.

Diagnosis. Body smooth, strongly depigmented; stygobitic. **Eyes** highly reduced, cornea indistinct and unpigmented. **Rostrum** relatively long, reaching end of 2nd segment to slightly beyond 3rd segment of antennular peduncle; rostral formula 3–11 + 1–8 / 0–5. **Stylocerite** short, reaching approx. 0.8 length of basal antennular segment. **Pereiopods:** **P1** stout, chela 1.8–2.1 times as long as wide; **P2** slender, chela 1.8–2.4 times as long as wide, carpus 3.8–4.3 times as long as wide; dactylus of **P3** ending in prominent claw-like spine, flexor margin with 4–6 spines; dactylus of **P5** with approx. 40 comb-like spinules on flexor margin. **Male first pleopod** endopod tongue-like, approx. 3.0 times as long as wide; appendix interna well developed, arising from distal 1/4 of endopod and overreaching distal margin. **Male second**

pleopod endopod slender, about ¾ length of exopod; appendix masculina strong, about 3/5 length of endopod; appendix interna reaching 3/5 of appendix masculina. **Telson** posterior margin rounded, without posteromedian projection, armed with 3–4 pairs of spinules. **Uropodal diaeresis** with 9–10 movable spinules.

Description. **Body** slender (Fig. 2B). **Rostrum** (Fig. 3A) slender, terminally tapering and slightly upturned, reaching from basal part of second segment of antennular peduncle to slightly overreaching third segment of antennular peduncle, 0.3–0.6 times as long as carapace. Rostral teeth tiny, with 4–19 (holotype 16) teeth dorsally, including 1–8 (holotype 8) situated posterior to orbital margin, ventrally with 0–5 (holotype 2) teeth, rostral formula: 3–11 + 1–8/0–5.

Eyes (Figs 2B, 3A) small, highly reduced, and unpigmented.

Carapace (Fig. 3A) smooth, glabrous, antennal spine blunt, pterygostomian margin subrectangular, pterygostomian spine absent.

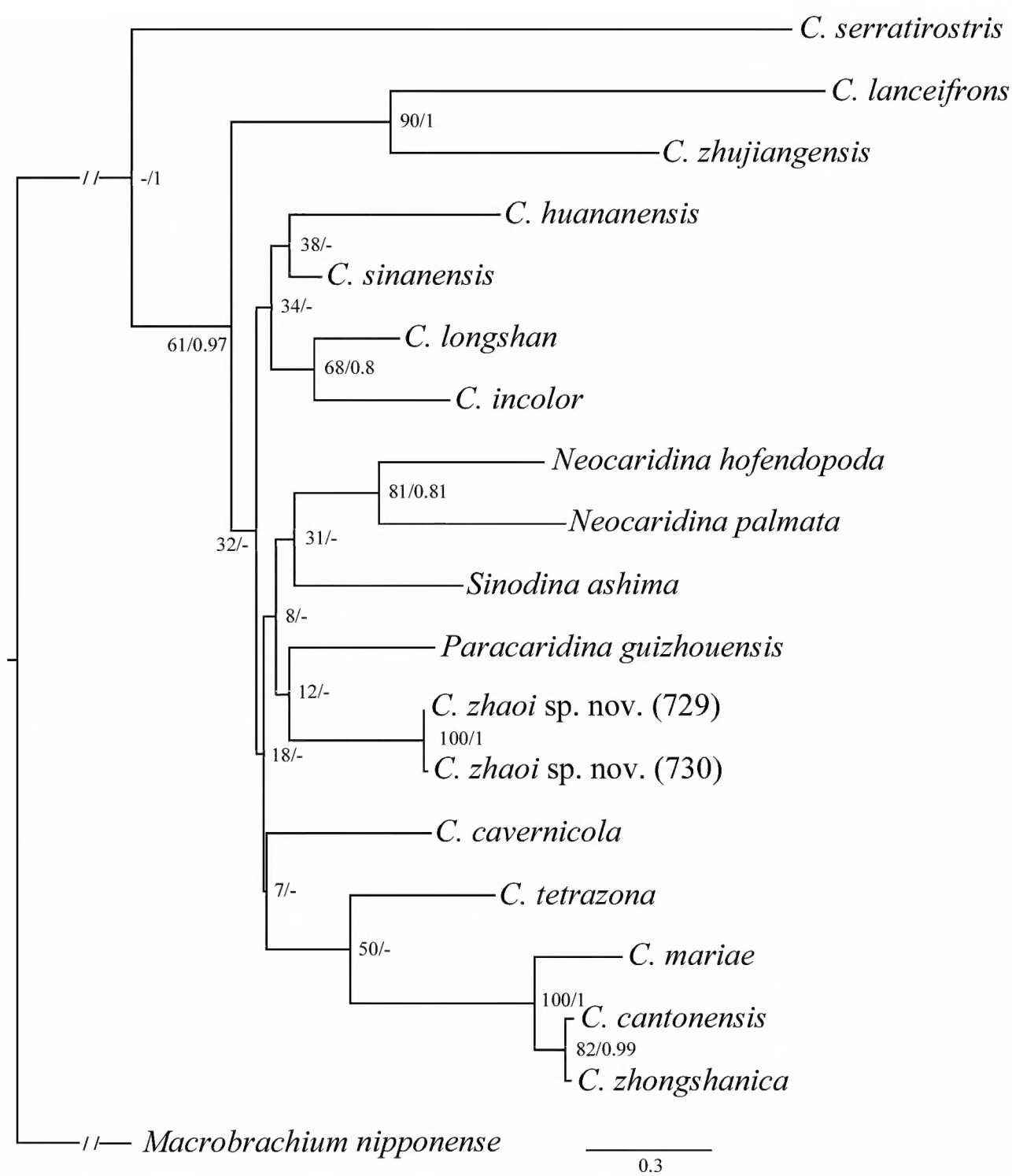


Figure 1. ML tree based on COI sequences. Numbers at nodes are maximum likelihood percent bootstrap values (left) and Bayesian posterior probabilities (right).

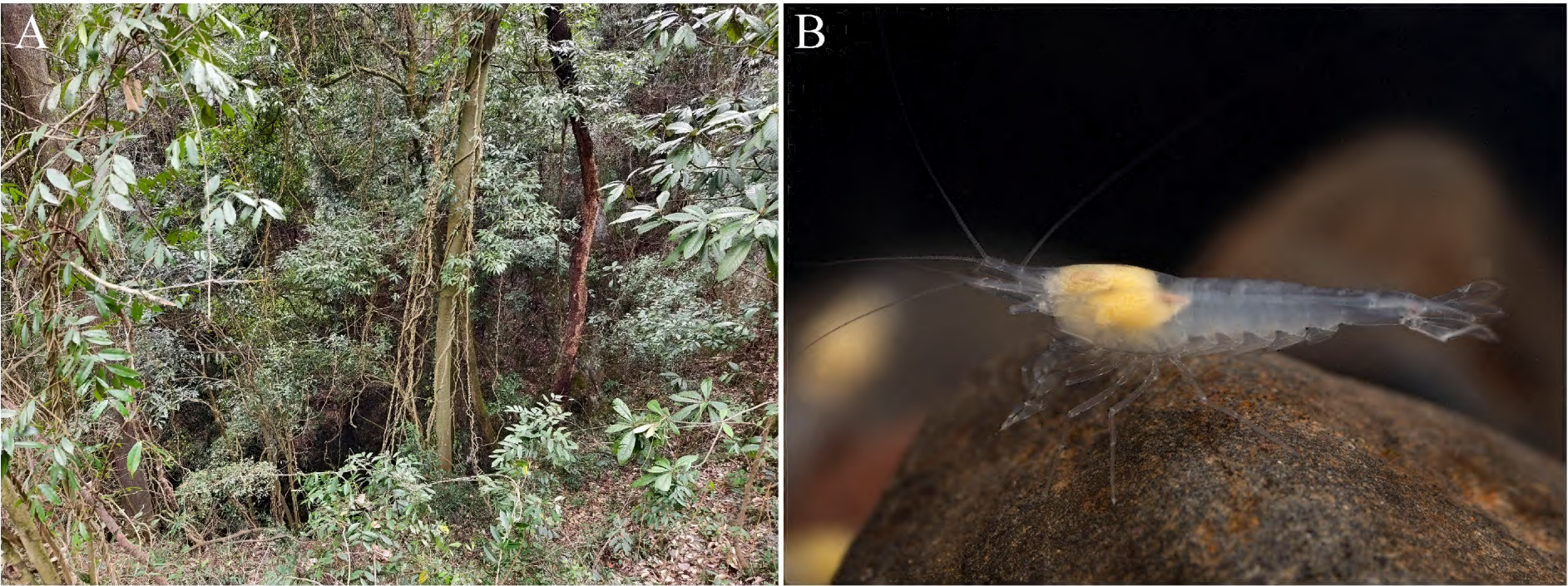


Figure 2. A. The entrance of Xiangshui Cave; B. Live specimen of *Caridina zhaoi* sp. nov..

Antennule (Fig. 3C) peduncle three-segmented. Basal segment about 1.6–1.7 times as long as second and 2.5–2.7 times as long as third. All segments with submarginal setae. Stylocerite reaching 4/5 of basal segment. Antero-lateral angle reaching one fourth of 2nd segment. Flagella long and simple.

Antenna (Fig. 3D) peduncle about half length of scaphocerite. Scaphocerite about 2.5–3.1 times as long as wide, outer margin straight, asetose, ending in a strong sub-apical spine, inner and anterior margins with long plumose setae.

Mandible (Fig. 3B) incisor process with four irregular and blunt teeth. Molar process ridged.

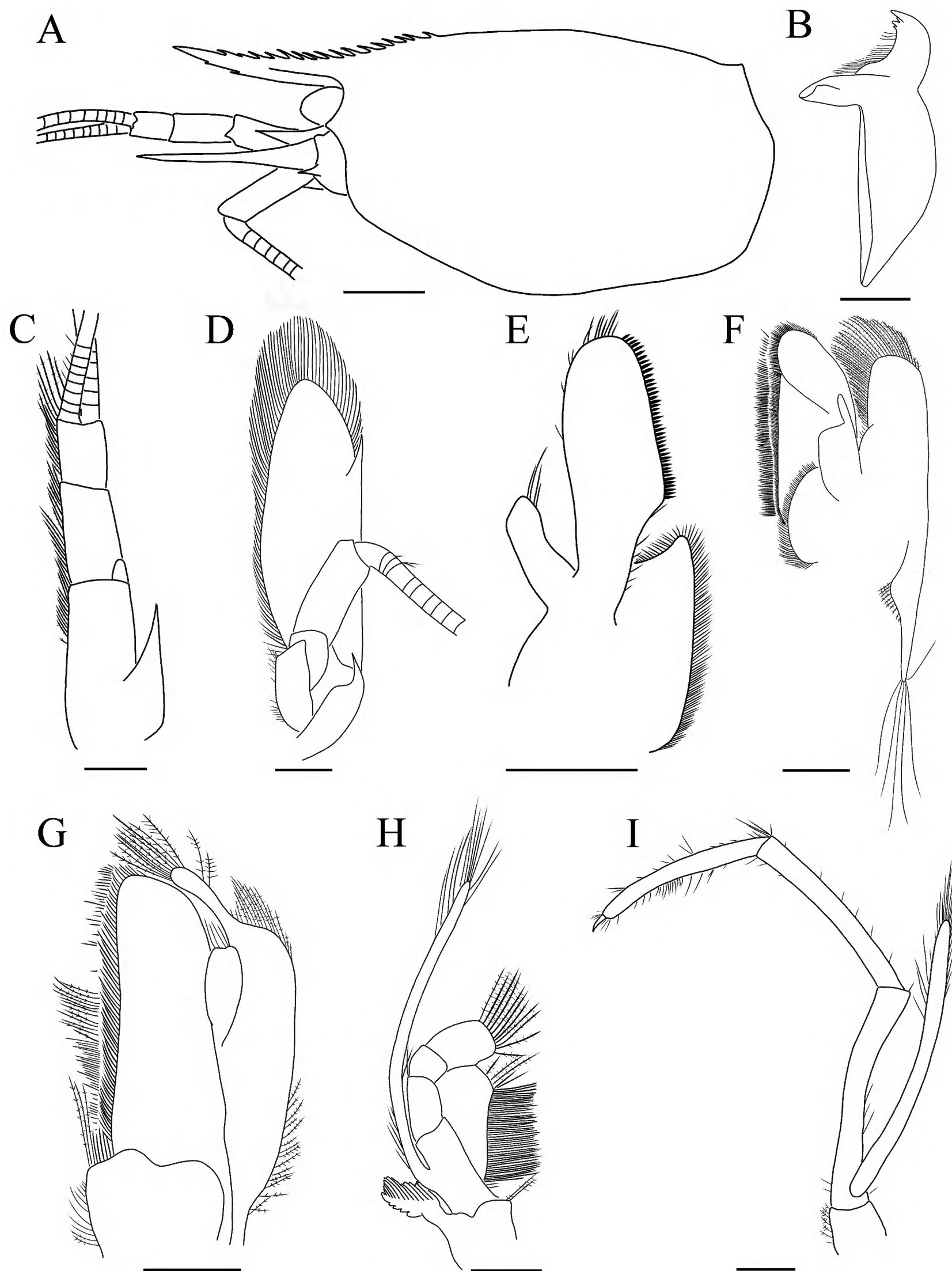


Figure 3. Holotype of *Caridina zhaoi* sp. nov. **A.** Cephalothorax and cephalic appendages, lateral view; **B.** Mandible; **C.** Antennule; **D.** Antenna; **E.** Maxillula; **F.** Maxilla; **G.** First maxilliped; **H.** Second maxilliped; **I.** Third maxilliped. Scale bars: 1 mm (**A**); 0.5 mm (**B–I**).

Maxillula (Fig. 3E) lower lacinia broadly rounded, with several rows of plumose setae. Upper lacinia elongate, with numerous small teeth and short setae on inner margin. Palp digitiform, with few long setae.

Maxilla (Fig. 3F) with palp slender and slightly curved. Upper endites subdivided. Scaphognathite tapering posteriorly with some long, curved setae.

First maxilliped (Fig. 3G) epipod small. Palp rounded, with several terminal plumose setae. Exopod flagellum distinct, well developed and with plumose marginal setae. Caridean lobe broad, with dense plumose marginal setae.

Second maxilliped (Fig. 3H) slender. Inner margin of ultimate segment with long straight setae, penultimate and basal segments with long plumose setae. Exopod

long and slender, with several plumose setae distally. Podobranch well-developed.

Third maxilliped (Fig. 3I) endopod three-segmented, basal segment about 1.2–1.3 times as long as second segment, second segment as long as distal segment, distal segment ending in small claw-like apical spine surrounded by simple setae, preceded by a clump of long and simple setae proximally. Exopod reaching beyond end of basal segment of endopod, with long plumose setae distally.

First pereopod (Fig. 4A) stout, chela about 1.8–2.1 times as long as wide, 1.3 times length of carpus, movable finger about 2.7–2.9 times as long as wide, and 1.3–1.8 times length of palm, fingertips rounded, with numerous long setae. Carpus excavated anterodorsally, 1.7–2.0 times as long as wide and as long as merus. Merus slightly narrower than carpus. Ischium about 0.5 length of merus and about 2 times as long as basis.

Second pereopod (Fig. 4B) slender and longer than first pereopod. Chela 1.8–2.4 times as long as wide, 0.8 times length of carpus. Movable finger 3.1–4.2 times as long as wide and 1.3–1.5 times as long as palm, setal brushes well developed. Carpus 3.8–4.3 times as long as wide, distal part normal. Merus 1.0 times length of carpus, 4.1–4.6 times as long as wide.

Third pereopod (Fig. 4C) dactylus 2.5 times as long as wide, ending in prominent claw-like spine surrounded by simple setae and 4–6 spines (Fig. 4E). Propodus 5.6–5.9 times as long as dactylus, bearing about 9–12 thin spinules on ventral margin, 10.8–12.8 times as long as wide. Carpus 0.6 times length of propodus, 4.7–6.1 times as long as wide. Merus 1.7–2.1 times length of carpus, 5.8–8.0 times as long as wide, with about 2–4 strong spines on the posterior margin. Ischium with a spine on the posterior margin.

Fifth pereopod (Fig. 4D) dactylus 3.2–3.4 times as long as wide, ending in prominent claw-like spine surrounded by simple setae, inner margin with about 40 comb-like spines (Fig. 4F). Propodus 4.8–5.3 times length of dactylus, bearing about 22 spinules in two rows on ventral margin, 12.7–16.6 times as long as wide. Carpus 0.5 times length of propodus, 4.7–7.1 times as long as wide. Merus 1.4 times length of carpus, 6.3–8.3 times as long as wide, with about 1–3 strong spines on the posterior margin. Ischium about 0.3 times length of merus.

First pleopod (Fig. 4G) male endopod about 3.0 times as long as wide, 0.5 times length of exopod, inner margin with short spine-like setae, distal margin with some long spine-like setae, and outer margin with long plumose setae, appendix interna well developed, arising from distal 1/4 of endopod, overreaching end of endopod by 1/3 its length, with cincinnuli distally. Exopod 4.2 times as long as wide.

Second pleopod (Fig. 4H) male endopod slender, about $\frac{3}{4}$ length of exopod. Appendix masculina prominent, about $\frac{3}{5}$ length of endopod, bearing some short, spine-like setae on basal and distal parts and some long spiniform setae on outer surface. Appendix interna reaching $\frac{3}{5}$ of appendix masculina, with cincinnuli distally.

Sixth abdominal somite ca. 0.52–0.54 times length of carapace, ca. 1.83–1.99 times as long as fifth somite, ca. 0.95–1.02 times as long as telson.

Preanal carina rounded, low, without spine.

Uropodal diaeresis with 9–10 movable spinules.

Telson (Fig. 4I) tapering posteriorly, without posteromedian projection, with 4–5 pairs of dorsal spiniform spines and one pair of dorso-subdistal spiniform setae; posterior margin with a pair of outermost and longest spines and 2–3 pairs of nearly equal long intermedial setae.

Color strongly degenerated and semitransparent, with yellow visceral organs in cephalothorax clearly visible (Fig. 2B).

Female with no distinct difference to male. Egg size unknown.

Etymology. The specific epithet is named after the collector Mr. Zhao Fei, an outstanding young speleologist.

Distribution. Guizhou (Guiyang), China.

Habitat. The habitat is defined by an approximately 200-meter-long underground river, situated at the bottom of a vertical shaft (ca. 90 m deep) (Fig. 2A). *Caridina zhaoi* sp. nov. was found concentrated in a pool at the terminus of this river. The depth of the pool is unknown. Water temperature remains constant at approximately 15 °C year-round. The new species is sympatric with the stygobiotic fish *Triplophysa wudangensis* Liu et al., 2022.

Remarks. *Caridina zhaoi* sp. nov. is a typical stygobiont, characterized by the strongly reduced body pigmentation and the degeneration of eyes, can be readily distinguished from surface-dwelling congeners by these stygobiotic adaptations.

Currently, the other recognized stygobionts of *Caridina* in China include *C. ablepsia* Guo et al., 1992, *C. acuta*, *C. alba* Li & Li, 2010, *C. alu* Cai & Ng, 2018, *C. caverna*, *C. demenica*, *C. incolor*, *C. longshan*, and *C. sinanensis*. The new species differs significantly from *C. demenica*, *C. acuta*, and *C. alba* in rostral morphology. *Caridina zhaoi* sp. nov. possesses a relatively long rostrum (reaching from the base of the 2nd segment to slightly beyond the 3rd segment of the antennular peduncle) with distinct dorsal teeth. In contrast, *C. demenica*, *C. acuta*, and *C. alba* have very short rostrums (usually not reaching the end of the 1st antennular segment) that are unarmed or bear only minute teeth.

Compared to *C. longshan*, the new species has fewer ventral rostral teeth (0–5 vs. 12–17) and stouter chelae on the first and second pereopods (ratios of 1.8–2.1 and 1.8–2.4, respectively, vs. 2.7 and 3.1 in *C. longshan*). It differs from *C. caverna* in the shape of the male first pleopod endopod (tongue-like vs. kidney-shaped/reniform in *C. caverna*) and the appendix masculina of the second pleopod (rod-shaped vs. distally swollen). It differs from *C. alu* by lacking eye pigment, having a shorter rostrum (vs. overreaching scaphocerite), fewer rostral teeth (vs. 16–24/4–12), distinctly slenderer pereopods (e.g., P1 carpus 1.7–2.0 times vs. 1.3 times) and the ratio of the endopod to exopod of male first pleopod (0.5 vs. 0.67). It differs from *C. ablepsia* by the stouter carpus of the

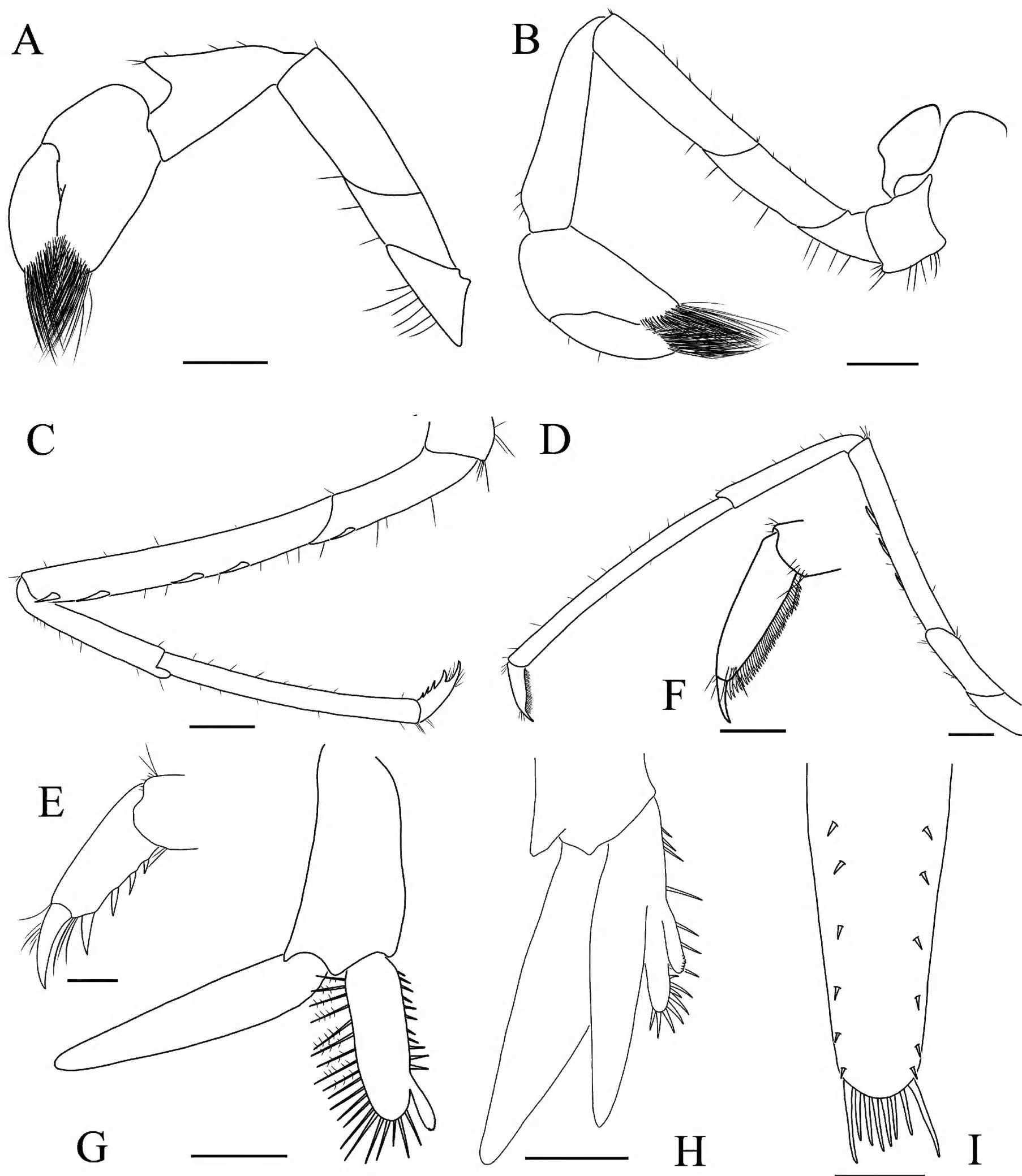


Figure 4. Holotype of *Caridina zhaoi* sp. nov. **A.** First pereiopod; **B.** Second pereiopod; **C.** Third pereiopod; **D.** Fifth pereiopod; **E.** Dactylus of third pereiopod; **F.** Dactylus of fifth pereiopod; **G.** First pleopod; **H.** Second pleopod; **I.** Telson. Scale bars: 0.5 mm (A–D, G–I); 0.25 mm (E, F).

second pereiopod (3.8–4.3 vs. 4.3–5.6), four pairs of spines on posterior margin of telson (vs. five pairs) and the absence of a posteromedian projection on the telson (vs. present in *C. ablepsia*).

Caridina zhaoi sp. nov. appears morphologically similar to *C. sinanensis* and *C. incolor*, both from Guizhou, but can be distinguished by specific combinations of characters. It differs from *C. sinanensis* by the complete lack of eye pigment (vs. pigment spot present), fewer ros-

tral teeth (dorsal 4–19/ventral 0–5 vs. 14–26/3–11), fewer spinules on the uropodal diaeresis (9–10 vs. 10–12), and the ratio of the appendix interna to appendix masculina (approx. 0.5 vs. subequal). From *C. incolor*, it is separated by a shorter stylocerite (reaching 4/5 of basal segment vs. reaching the end), stouter first pereiopod carpus (L/W 1.7–2.0 vs. 2.3–2.7) and second pereiopod carpus (3.8–4.3 vs. 5.4–5.6), and fewer spinules on the dactylus of the fifth pereiopod (ca. 40 vs. 50–55).

The new species also shows clear morphological differences from geographically proximate epigean species found in Guiyang, i.e. *Caridina guiyangensis* Liang, 2002 and *Caridina cavalerieioides* Liu & Liang, 2003. Aside from stygobiotic traits (color/eyes), *C. zhaoi* sp. nov. lacks the protrusion at the base of the appendix interna on the male first pleopod observed in *C. guiyangensis*. Furthermore, the new species lacks a posteromedian projection on the telson (present in both *C. guiyangensis* and *C. cavalerieioides*), has a shorter stylocerite, fewer ventral spines on the dactylus of the third pereopod (4–6 vs. 5–8 or 7–8), and fewer spinules on the uropodal diaeresis (9–10 vs. 13–15 or 12–14).

Molecular analysis based on the mitochondrial COI gene reveals high interspecific genetic divergence between *C. zhaoi* sp. nov. and other comparison species, ranging from 14.70% to 23.47%. This huge value strongly supports its validity as a distinct lineage. However, due to the limited availability of reference sequences for Chinese cave atyids in public databases, the exact phylogenetic position of the new species remains unresolved. Further sampling and multi-locus analyses are required to elucidate its evolutionary relationships.

Discussion

To date, 28 cave-dwelling species of Atyidae have been documented in China, belonging to five genera: *Caridina* (22 species), *Mancicaris* (1 species), *Neocaridina* (1 species), *Sinodina* (1 species) and *Typhlocaridina* (3 species) (Cai and Ng 2018; Xu et al. 2020; Feng et al. 2021; Guo et al. 2022; Jiang et al. 2023). These species are distributed across the karst regions of southern China, with the highest diversity found in Guangxi (11 species) and Guizhou (9 species), followed by Yunnan (4 species), Hunan (3 species), and Hubei (1 species).

The description of *Caridina zhaoi* sp. nov. elevates the total count of Chinese stygobiont atyids to 15 species, with 10 belonging to *Caridina*. Among these obligate cave-dwelling taxa, Guizhou emerges as the most diverse region, harboring six species, surpassing Guangxi (3 species), Yunnan (2 species), Hunan (3 species), and Hubei (1 species).

The discovery of *C. zhaoi* sp. nov. aligns with a growing trend of novel stygobiont taxa being identified in southern karst areas of China, suggesting that subterranean biodiversity in this area remains significantly underestimated. Given the fragmented nature of current taxonomic and phylogenetic data, integrative studies combining morphological analyses, molecular phylogenetics, and biogeographic modeling are urgently needed. Such multidisciplinary approaches will clarify the evolutionary trajectories, speciation drivers, and ecological adaptations of these unique groundwater communities, while informing conservation strategies for their fragile karst habitats.

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